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a little higher, *mu*, with vowels in order. So much for this wonder, if it be the right one; and it was shown to me as such by one who knew it to be so."

The following Note "On the Force of aqueous Vapour within the Range of atmospheric Temperature," was read by James Apjohn, M.D., M.R.I.A., Professor of Chemistry in the Royal College of Surgeons.

Having had it in contemplation some time since to investigate by means of an indirect, but I believe a very accurate process, the caloric of elasticity of the vapours of several liquids, I found myself stopped on the threshold of the inquiry by a want of knowledge of the tension of such vapours at different temperatures; for, with the exception of the vapours of water, alcohol, ether, and oil of turpentine, the tension of no others had been made the subject of experiment; and even in the case of the fluids just named, the results recorded in the books appeared to me very far from being of such a nature as to preclude the necessity of further research.

The method which I intended to employ, in order to arrive at the latent heats of vapours, not requiring a knowledge of their tensions beyond the range of atmospheric temperature, it occurred to me, that the necessary data for the solution of the preliminary problem might be obtained with facility, and, at the same time, with much precision, in the following manner:

Let a known volume of dry air be charged with moisture at any given temperature, and let the expansion produced by the moisture be accurately noted. The pressure being also measured by an accurate barometer, we have the means of calculating the force of the vapour which has produced the expansion. For if v be the volume of the dry air, and v' that of same air when charged with moisture, f the force

of the vapour, and p the existing atmospheric pressure, we shall have

$$v' = v \times \frac{p}{p-f},$$

from which we deduce

$$f = \left(\frac{v'-v}{v'}\right) \times p.$$

It was not my original intention to make any experiments upon the force of *aqueous* vapour, believing the table which I have hitherto employed, and which was calculated by the author of the article "Hygrometry," in Brewster's Encyclopædia, from the experiments of Dalton, to have been sufficiently exact. But the correctness of this table having been indirectly called in question by so high an authority as Mr. Kupffer, who has come to the conclusion, that the table of the force of aqueous vapour, given by a German meteorologist, of the name of Kämtz, is alone to be relied upon, I resolved to commence with the vapour of water, in the hope that I might be able, by the results of direct experiment, to corroborate a conclusion previously drawn by Professor Lloyd, from a discussion of some hygrometrical observations of mine, viz., that for temperatures within the atmospheric range, the table of Kämtz is less accurate than that of Dalton, the values given in the former being all too low.

The apparatus I have employed in my experiments is composed of a glass ball prolonged on the one side into a short tube, furnished with a cap and stopcock, and, on the other, into a long tube of somewhat smaller diameter, divided into 100 equal parts, each being .042 of a cubic inch, or the .001 of the total capacity of ball and tubes down as far as the division marked 1000.

The first step consisted in filling this vessel with dry air, which was done in the following manner : into the extremity

of the graduated tubular portion, a cork pierced by a small tube, open at both ends, was inserted, and this tube was then connected with the orifice of a table air-pump usually occupied by a syphon gauge. The stop-cock was now connected with one end of a long tube, packed with fragments of fused caustic potash, while the other end of this tube was attached by means of a slip of caoutchouc to a second tube passing through an air-tight cork fixed in one of the mouths of the bottle, at present used for the inhalation of chlorine. This bottle being charged with oil of vitriol, and the orifice of the plate of the pump being closed, the pump was worked, and a current of air was thus drawn through the glass vessel for about fifteen minutes, which in passing through the oil of vitriol, and over the fused potash, was deprived of all hygrometric moisture. The included air being now absolutely dry, the stopcock was closed, and the small tube connecting the air vessel with the pump having been drawn out in the middle, and sealed hermetically by means of a spirit lamp, the air apparatus was separated from the potash tube, and transferred to a tall jar containing mercury, after which the sealed end of the small glass tube was broken beneath the surface of the quicksilver. The apparatus, however, being now completely filled, it became necessary to remove some of the air, and this was done by opening the stopcock very gradually, care being taken that during this manipulation the external mercury should be higher than its level within the tubular portion. The entire was then placed in a small room, the temperature of which was found not to vary more than one degree Fahrenheit during the twenty-four hours, the stopcock having been first attached to one extremity of a string, which was carried over a fixed pulley placed in the ceiling, and whose other end carried a counterpoise by which the air vessel was kept in a vertical position, and the observer was enabled readily to bring the mercury within

and without to the same level, before he registered the volume of the included air.

On the next day, after the apparatus was mounted, and the four following ones, the volume of the dry air, its temperature, and the existing pressure were accurately noted. This pressure, which was measured by a portable barometer of Newman's, having undergone a variety of corrections, for the capacity of the cistern compared to that of the tube, for the excess of the temperature of the quicksilver over 32°, for capillarity, and for a constant error by which I found my barometer affected, when compared with the standard instrument in the Observatory of Trinity College, I reduced by calculation in each instance the observed volume of air to what it would be at 32°, and under a pressure of 30, using for the expansion of air the corrected coefficient $\frac{1}{493}$, which has resulted from the experiments of Rudberg, and thus obtained the following numbers, which, it will be observed, differ very little from each other.

1	911·11
2	911·85
3	910·21
4	913·30
5	911·72

911·64, therefore, the mean of the five observations, may be assumed as the true volume of the included dry air, at 32°, and under a pressure of 30.

The volume of the dry air being determined, the next step was to charge it with moisture. In order to accomplish this, the air vessel was lifted by means of the string, so as that the mercury within should be about an inch higher than the external mercury, and distilled water was then poured into the upper cavity of the stopcock, so as completely to fill it. The stopcock was now cautiously turned, so as to admit the entrance of the moisture *guttatim;*

and more water being occasionally poured on, this manipulation was repeated until the mercury within came to be covered by a film of water of about one-tenth of an inch in thickness. The stopcock was now closed, and the apparatus being lowered, the whole was left to itself until the following day, when the first of a series of observations, continued for twenty successive days, was made, each comprehending the volume of the moist air, the pressure, and the temperature both of the air and of the mercury in the barometer. To deduce from these by the formula $f = \frac{v' - v}{v'} \times p$, the force of vapour, it was necessary, in the first instance, to apply to p all the corrections already explained, and in addition to raise 911·64, the volume of the dry air, to what it would be at the temperature and pressure of the moist air, as noted in each observation. But, as this involved tedious arithmetical computations, and as the thermometer during the performance of the twenty experiments varied only about 15°, I came to the resolution, being at the time upon the eve of leaving town for a couple of months, to postpone the calculations until I should be possessed of *data* applicable to the solution of the problem I had undertaken, throughout a more extended range of temperature.

Accordingly, in November last, I resumed the subject with the very same apparatus, which had been left *statu quo* in the interval, and succeeded in completing a series of forty-five additional observations, extending nearly as low as 32°, and which I had every reason to expect would lead to satisfactory results. Upon, however, submitting the whole to calculation, I have been led to the mortifying conviction, that in consequence either of the absorption of the oxygen by the mercury and brass-work, or some accident which befel the apparatus during my absence from town, the entire of the latter series of observations is of no value, as they lead to results for the force of aqueous vapour, which

are certainly greatly below the truth. Upon the present occasion, therefore, I can direct attention only to the observations made in July and August last. These are contained in the following table, and, as has been already stated, they amount to twenty in number, the highest temperature having been 65°, and the lowest 49°·6. The numbers in the last column represent the bulks which the 911·64 volumes of dry air would have, if reduced to the temperature *t*, and the corrected pressure *p*.

TABLE I.

v'	t	p observed	Temperature of Barometer.	p corrected.	911·64 reduced to t and p corrected.
1001	60·4	29·450	59·9	29·430	982·82
1001·5	59·8	29·364	60·1	29·338	984·77
997	60	29·548	60	29·524	978·94
984	59·1	29·822	59·5	29·807	967·97
977	58·4	29·980	58·6	29·971	961·38
984	58·4	29·780	58·9	29·767	967·97
991	59	29·624	59·4	29·607	974·33
983·5	59·4	29·862	59·8	29·847	967·23
979·5	60·2	30·100	60·6	30·086	962·69
977·5	61·2	30·132	61·3	30·165	960·35
983	61·6	30·05	62·2	30 037	965·18
973 3	62·2	30·230	62·4	30·212	960·69
978·4	61·6	30·214	62·2	30·197	960·06
983·5	63·1	30·156	63·6	30·131	964·93
987·5	64·3	30·130	64·7	30·104	968·01
991	64·1	30·032	64·6	30·005	970·83
994·5	64·8	29·989	65	29·961	973·55
994·5	65	29·972	66	29·940	974·61
989	65·2	30·152	66·5	30·120	969·12
1000	64·8	29·834	65	29·306	978·62

From the first, last, and second last columns of the pre ceding table, the force of aqueous vapour has been calculated in the manner already explained. The values thus obtained are exhibited in the second column of Table II.

Column 1 contains the temperatures; column 3 the tensions, as deduced from Dalton's experiments ; and column 4 the same as given by Kämtz.

TABLE II.

1	2	3 Dalton.	4 Kämtz.
60°·4	·5345	·5302	·5125
59 ·2	·4908	·5197	·5023
60 ·	·5348	·5232	·5061
59 ·1	.4855	·5077	·4893
58 ·4	·4917	·4960	·4768
58 ·4	·4849	·4960	·4768
59 ·	·4980	·5060	·4875
59 ·4	·4937	·5128	·4949
60 ·2	·5169	·5265	·5093
61 ·2	·5292	·5444	·5261
61 ·6	·5445	·5517	·5343
62 ·2	·5412	·5628	·5458
61 ·6	·5660	·5517	·5343
63 ·1	·5689	·5798	·5615
64 ·3	·5941	·6033	·5860
64 ·1	·6107	·5993	·5824
64 ·8	·6311	·6133	·5949
65 ·	·5988	·6173	·5985
65 ·2	·6054	·6214	·6029
64 ·8	·6372	·6133	·5949

When the corresponding numbers in the three columns are compared, it will be at once observed, that the values of f, investigated by the method just explained, are somewhat less than those extracted from the table I have been hitherto in the habit of using; but that they are considerably greater than the values of Kämtz, the differences being generally better than twice as great in the latter instance as in the former. This will be more manifest by taking a mean of the different results in column 2, and comparing it with the force

of vapour corresponding to the same temperature as given in the two other tables. Now, the mean of the temperatures is 61°·63, the quotient got by dividing their sum by twenty. But the corresponding mean value of f, in column 2, must be differently calculated, seeing that the temperature and the corresponding tensions of the vapour augment at a very different rate. For temperatures, in fact, in arithmetic progression, the corresponding tensions are in geometric progression; and, although this is well known to be but an approximate law, it may be considered as rigorously true for the limited range of temperature within which my experiments have been made. To calculate, therefore, the mean force of vapour, as deducible from the numbers in column 2, and which must correspond to the temperature 61°·63, it is only necessary to add together the logarithms of the numbers in this column, and divide their sum by twenty, and the quotient will be the logarithm of the mean. When this process is gone through, the mean logarithm is found to be 73699, and the corresponding number ·54575. The following, therefore, are the tensions of aqueous vapour at 61°·63, as deduced from my experiments, and as extracted from the tables of Dalton and Kämtz.

	My Experiments.	Dalton.	Kämtz.
61°·63, . .	·5457 . . .	·5523 . .	·5349

Difference between Dalton's number and mine, = +.0066.

Difference between Dalton's number and that of Kämtz, = + .0174.

It thus appears, that the result at which I have arrived is somewhat less than the Daltonian number, but considerably greater than that given by Kämtz; and that, therefore, my experiments, as far as they have been discussed, give at least a *prima facie* countenance to the opinion, that the values of the elastic force of aqueous vapour, as given by the latter philosopher, are, at and about 61°·63, below the truth.

Before, however, this conclusion can be considered as fully established, and before we can judge correctly of the amount of the errors by which his table is affected, it will be necessary to inquire whether the thermometer I have employed be a true one. This essential inquiry I have been enabled to institute by my friend, Professor Lloyd, who has put into my possession, for the purpose, a thermometer given him by Professor John Phillips, together with a table of differences between it and the standard thermometer belonging to the Royal Society. Upon a comparison of the two instruments, I find, that at and about 60°, the thermometer I have employed stands ·6 of a degree higher than that lent me by Professor Lloyd. while the latter stands ·3 of a degree higher than the standard in possession of the Royal Society; so that the indications of my instrument are at 60°· 9-10ths of a degree higher than the truth. If such be the case, ·5457, instead of being the force of vapour at 61°.63, is the force at $61{\cdot}63 - 0{\cdot}9 = 60^\circ{\cdot}73$; and to compare the result of my experiments with the tables of Dalton and Kämtz, it is only necessary to extract from these the values of the force of vapour corresponding to the temperature 60°·73.

	My Experiments.	Dalton.	Kämtz.
60°·73 . .	·5457 . . .	·5361. . .	·5157

Difference between Dalton's number and mine — ·0096.

Difference between Dalton's number and that of Kämtz + ·0184.

The consideration, therefore, of the error of my thermometer, and the allowance made for it, only strengthens the conclusion already arrived at; and I do not now feel any difficulty in giving it as my deliberate opinion, that the table of the force of vapour given by Kämtz is, within the atmospheric range of temperature, erroneous, his values being all too low.

Dr. Anster, on the part of the Rev. Dr. Luby, F.T.C.D., presented to the Academy the original letter of the Rev. C. Wolfe, which he had read at a former Meeting, and of which a *fac-simile* is published in the present Number of the Proceedings. (See p. 90.)

The special thanks of the Academy were voted to Doctor Luby for the donation of this very interesting document.

Professor Mac Cullagh presented to the Academy three additional ornamented plates belonging to the cross of Cong. When the cross came into his possession, these plates were missing; but they were lately recovered for him by the exertions of a friend. The front of the cross is now complete, and only one plate is left wanting at the back.

DONATIONS.

Astronomical Observations made at the Honourable the East India Company's Observatory at Madras, for the Years 1831—39. Vols. I.—V. Presented by the Court of Directors.

Journal of the Statistical Society. Vol. IV. Part 1. Presented by the Society.

Contributions towards the History of Swansea. By Lewis W. Dillwyn, F.R.S., &c. Presented by the Author.

Mémoires préséntes par divers savants a l'Académie Royale des Sciences de l'Institut de France; Science Mathématiques et Physiques. Tome V.

Mémoires de l'Institut Royal de France, Académie des Inscriptions et Belles Lettres. Tomes XI., XII., XIII., and XIV.; Part 2.

Mémoires de l'Institut de France, Académie Royale des Sciences. Tome XIV.—XVII.

Séance Publique Annuelle de l'Académie Royale des Inscriptions et Belles Lettres, du Vendredi 25th Septembre, 1840.